Remarks

Claims 1-9, 13-19, and 28-46, and 56-61 are pending in the application. Claims 10-12, 20-27, and 47-55 were withdrawn from consideration based on an election of species requirement. Claims 1, 40, and 56 have been amended. No new matter has been added by virtue of this response. Reconsideration of the application in view of this amendment is requested.

Claim Rejections - 35 U.S.C. § 112, second paragraph

The Examiner rejects claim 29 under 35 U.S.C. § 112, second paragraph, as being indefinite. The Examiner states that "claim 1 recites that the time varying input tuning input signal that is applied to the control input 'is independent of a signal amplified by said power amplifier,' yet claim 29 says that an envelope detector is connected to the control input and is 'responsive to an input RF signal.' The 'signal to be amplified by said power amplifier' is the input RF signal and thus claim 29 is contradictory to that of claim 1 that requires signal applied to the control input to be independent."

Applicant would respectfully ask the examiner to consider that claim 29 may be contradictory under an interpretation of claim 1 adopted by the Examiner that claim 1 was referring to the "signal **to be** amplified by said power amplifier." Applicant would also respectfully ask the Examiner to consider that a non-contradictory interpretation of claim 1 is the interpretation of the version of claim 1 in amendment K that is made explicit by the current amendment, that the time varying tuning input signal is independent of the amplified signal. This is consistent with the fact that claim 1 stated "An electronically tuned circuit, comprising a power amplifier coupled **to provide amplified signal** to an electronically tunable output network. . ." The amendment to claim 1 more clearly states that "said time varying tuning input signal is independent of said **amplified signal.**"

Claim Rejections - 35 U.S.C. § 112, first paragraph

The Examiner rejects claim 35 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The Examiner states that "Figures 17-18 that relates to a drive level controller that is controlled by a external means fails to describe the use of sensing the threshold to determine whether the drive level controller is used or the tuned filter is used."

Applicant would respectfully ask the Examiner to consider that in the last paragraph on page 17, applicant described the "transition between the two ranges," which is another way of saying the word "threshold" as used in claim 35. In the first paragraph

on page 18, applicant described the addition of controller 61 in FIG. 18 which "uses analog functions, a digital look-up table, or other suitable means to translate modulation input 60 into a suitable drive-control signal 142 and filter-control signal 15." Thus, applicant described how to determine whether the drive level controller is used or the tuned filter is used. Thus, the rejection claim 35 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement has been traversed.

Claim Rejections-- 35 U.S.C. § 103(a)

The Examiner rejects claims 1-9, 3-19, 28, 30-34, 36-38, 40-46, and 56-64 under 35 U.S.C. § 103(a), as being unpatentable over Bosse in view of Clar as evidenced by Ishii. The Examiner states that "Figure 5 and the relevant text of Bosse discloses an electronically tuned circuit that is part of the output network of an amplifier arrangement. The two electronically tunable non-motor driven solid-state elements 71 and 68, commonly called varactors, are part of the output network and are capable of being tuned via a voltage." The Examiner further states that "in the output network there is at least one control line 8 that forms at least one control input for the electronically tunable components." The Examiner also states that the potentiometer 13 allows the control signal to vary over more than two values over time." Also that "this potentiometer can be called a 'controller.'"

First, applicant would respectfully ask the Examiner to consider that items 8 and 13 are not found in the embodiment illustrated in figure 5 of Bosse. Bosse provides figure 5 as an alternative embodiment to the embodiment of figure 1, and in this figure 5 embodiment double pole double throw switch 9 with terminal 8 and potentiometer 13 of figure 1 do not appear and do not appear to be needed. While the embodiment of figure 1 of Bosse has no transistor, the alternate embodiment of figure 5 of Bosse has no switch and no potentiometer. Further invention would be required to combine the teachings of these different embodiments of these figures two figures to include switch 9, terminal 8, and potentiometer 13 from figure 1 along with many other elements of figure 5 that Bosse says operates similarly.

Bosse does not appear to teach or suggest a control line to his variable capacitance devices 71 and 68 as described in claim 1: "wherein said control line extends to said electronically tunable reactive component for providing a control signal derived from said time varying tuning input signal." To the extent FIG. 5 in Bosse includes lines that may be considered control lines (without numbers extending to the bottom of FIG. 5), nothing in Bosse teaches or suggests that they are time-varying. Nor does anything in Bosse teach or suggest that they have anything to do with the input signal.

Furthermore, the output of the circuit of figure 5 of Bosse is taken through coil 57

which is coupled to coil 53. Diodes 71 and 68 are not part of the circuit of output coil 57.

Furthermore, in the circuit of Figure 5, all DC-input current flows through resistor 55 or 56, and RF power is dissipated in these resistors as well. In a small-signal amplifier, a resistor like resistor 55 or 56 is often used to regulate bias, improve stability, set gain, etc., and the power dissipated is unimportant. Such a resistor would not be used in a power amplifier as it would dissipate significant power, produce heat that must be dissipated somewhere, and reduce efficiency. Using a resistor that is small enough so that the power dissipation was negligible would not result in any benefits to stability, gain control, etc. A power amplifier simply uses choke 54 for DC feed. This can be seen in FIGS. 3, 4, 13, 15, 20, 21, and 22 of the present patent application and in numerous text books. Thus one of ordinary skill in the art would understand from Figure 5 of Bosse that he envisioned a small-signal amplifier, not a power amplifier.

Bosse describes his various embodiments for accomplishing a common purpose. With regard to FIG. 4, in column 4, lines 3-4, Bosse says this circuit is "for reception." Receiving amplifiers use small-signal operation to provide low noise, low cross-modulation, high gain, etc. This means is it a small-signal amplifier, not a power amplifier.

Even if the amplifier of Figure 4 were a power amplifier, the varactors are applied to the input, not the output, and the active device 42 is a bipolar transistor. Small variations in the base voltage of a bipolar junction transistor cause large variations in its collector current. Consequently, the ac voltage on the base is always small; for example it might cause an excursion of +-0.05 V around a bias of 0.75 V. In contrast, the varactors are biased at least several volts when used for tuning. Clearly the varactors of FIG. 4 are for a small-signal situation.

Finally, neither the circuits of Bosse nor the text suggests or hints at providing the transistor 50 of figure 5 operating as a power amplifier operating in a large signal mode coupled to provide amplified signal to an electronically tunable output network that has an electronically tunable reactive component. Bosse neither teaches nor suggests that transistor 50 has a large signal output. Nor does he teach or suggest using an electronically tunable reactive component in the output circuit of a power amplifier, as described in claim 1. Although one can imagine that a large range of amplitudes may be provided by transistor 50 in the circuit of figure 5, that range of amplitudes is sharply restricted because of the presence of diodes 71, 68 with their variable capacitances that could distort the signal from transistor 50, as described in numerous text books on the subject of electronically tunable capacitors (also known as varactors and as tuning diodes). These books show that **experts in the field were teaching against the very idea of using large signals across variable capacitances.**

The books mentioned herein were used in Amendment D to address the Sokal and Shenai references previously cited by the Examiner. They apply equally to the circuit described in Bosse. In section 12.2.3, entitled "Varactor diodes," the book Introduction to Microwave Circuits by R. J. Weber, published by Wiley Interscience, New York, 2001, pages 286-287 states (attached):

> A varactor (variable capacitor) diode is a semiconductor junction diode. The parasitic series resistance of a varactor diode is of primary consideration in maximizing the Q of the diode. The depletion region of the semiconductor junction acts as a capacitor. The dc voltage across the diode determines the depletion width and thus the depletion capacitance of the varactor. The **RF voltage** across this depletion region **must be small** with respect to the dc voltage across the diode **if harmonic generation is to be minimized.** However, often harmonic generation is the desired result in frequency-multiplier circuits.

Weber teaches that the signal **must** be small when varactor diodes are used if harmonic generation is to be minimized (as in an amplifier). Thus, Weber clearly teaches against using varactor diodes for amplifying a high voltage signal. In addition to small-signal applications where harmonic generation is to be avoided, Weber notes that the varactor diode can also be used for harmonic generation, such as in frequency multipliers, which take advantage of the non-linear feature of the varactor. Thus, Weber, teaches against the idea of a power amplifier coupled to an electronically tunable output network in which the output network includes an electronically tunable reactive component.

In Section 2-1-4, entitled "Tuning Diodes," the book RF/Microwave Circuit Design for Wireless Applications, by U. L. Rohde and D. P. Newkirk, Wiley Interscience, 2000, New York, (attached) also teaches against using varacters (or tuning diodes as they are called in this book) for amplifying large signals. Beginning on page 153, the section provide a detailed discussion of tuning diodes. On p. 168 the authors discuss distortion products. They note that in case of frequency multiplier, distortion products are desirable, but "for other applications, **such as tuning-diode-tuned linear circuits, distortion products are extremely undesirable**, and in some instances the end product specification may set a maximum limit on the distortion products allowed." The authors present several problems, such as cross modulation, intermodulation, and harmonic distortion, that limit use of a tuning diode, even for small signal amplifiers.

Rohde and Newkirk then show several circuits (pages 170, 172) that cancel some (but not all) of the distortion products. Thus, the distortion products clearly remain a problem, even in the small-signal applications that they are discussing. And even for the

small signal applications the partial solution Rohde and Newkirk provide is more complex than merely substituting a single varactor for a mechanically tuned capacitor.

On p. 186, Rohde and Newkirk explain how electronically tunable capacitors work, and then state clearly the limits of such devices:

> In normal operation, the sum of the tuning voltage and the alternating signal voltage of the resonant circuit is applied to the tuner diode. The bias, and thus the capacitance, of the turner diode therefore varies at the rhythm of the alternating voltage. Due the nonlinear character of the capacitance versus voltage curve, voltage distortions and capacitance shifts are inevitable, and these must be kept within adequate limits. **This is done by maintaining the ac applied to the diode(s) at a sufficiently low ac amplitude** and by choosing an adequate minimum value for the tuning voltage."

Thus Rohde and Newkirk teach against the idea of providing a high level signal to their tuning diodes. One of ordinary skill in the art would conclude that tuning diodes were suitable only for small-signal use, and even there, distortion and harmonics are a problem that must be avoided. Thus, Rohde and Newkirk teach against the idea of a power amplifier coupled to an electronically tunable output network, in which the output network includes an electronically tunable reactive component.

This conclusion is further supported in Section 3-6 of Rohde and Newkirk, which discusses voltage-tuned filters at some length. The discussion for filters demonstrates further why one of ordinary skill would be averse to using the tuning diodes for power amplifiers. Fig. 3-148 shows a standard plot of output versus input. The top curve 1F is the desired output v. input which follows a straight line from -20 dBm to about -10 dBm input level, which is equal to only about 100 microwatts. For an input of -20 dBm, or 10 microwatts, the distortion is well below the signal level, as shown by the straight line characteristic of curve 1F along the left hand portion of the curve. Above -10dBm the solid line is the actual output v. input which drops below the dotted straight line, which is the ideal linear characteristic. The difference between these curves is the magnitude of the distortion. Thus, above -10 dBm the distortion becomes significant and causes the actual output (solid line) to differ from the ideal linear output (dotted line), and that difference increases with input power level above only this -10dBm level.

The bottom curve, IM3, is one of many distortion products produced. for a typical VHF tunable filter. Here it is seen that this distortion product increases rapidly with signal level, and it makes the filter unsuitable for use certainly above a small input level.

Furthermore, the distortion increases rapidly with signal level and is equal to the

signal level at a power of only 0 dBm or about 1 mW (one milliwatt), hence Rohde and Newkirk teach that the tunable filter is suitable only for low-power, small-signal operation. One of ordinary skill would look at the intercept point, the point where the signal and the distortion are equal. That occurs for this device at only about 0 dBm or about 1mW. Thus, this filter is good for no more than 1mW of signal.

Fig. 3-149 shows a so-called "high-dynamic range" tunable filter. Its distortion characteristics, shown in Fig. 3-151 shows distortion beginning at 10 dBm which is equal to 10mW, which is still a small signal. The intercept point where linear portions of the two curves meet is at a signal level of +18 dBm (63 mW). At this point the signal and the distortion product are of equal amplitude. One would want to operate 20dBm lower than this point to keep distortion and harmonics to acceptable levels. And this is much less than the input power amplified by a power amplifier. To achieve a realistic distortion requirement of -30 dBc (distortion 30 dB lower than the signal), the maximum signal level is +3 dBm (only 2 mW), which, despite the name "high dynamic range" given by Rohde and Newkirk, is still clearly low-power, small-signal operation.

The discussion of varactor diodes in the book by F. Losee, RF Systems, Components, and Circuits Handbook, Artech House, 1997, Boston, (attached) is typical of many books in this field. In Sec. 17.6, on p.503, Losse says that varactors find application in frequency modulation and oscillator tuning, as well as frequency multipliers. The first two applications are small-signal. As noted in Sec. 6.3, p. 163, frequency multipliers make use of the "nonlinearity inherent in any semiconductor diode." There is no teaching or suggestion of using varactors for power amplification.

Following is a list of ten other books that show similar applications, all of which provide only small signal level application for amplification. The only other case discussed is where the harmonics are desired, and these are not for power amplification.

BOOKS THAT MENTION VARACTORS

All of the following books discuss the use of varactors in small-signal applications such as oscillators, modulators, and phase shifters, and in some cases, frequency multipliers. None teach or suggest the idea of providing varactors for amplifying large signals.

H. L. Krauss, C. W. Bostian, and F. H. Raab, Solid State Radio Engineering. New York: Wiley, 1980.

P. B. Kenington, High Linearity RF Amplifier Design. Norwood, MA: Artech, 2000.

P. Vizmuller, RF Design Guide: Systems, Circuits, and Equations. Norwood,

MA: Artech, 1995.

S. C. Cripps, RF Power Amplifiers for Wireless Communication. Norwood, MA: Artech, 1999.

S. C. Cripps, Advanced Techniques in RF Power Amplifer Design. Boston, MA: Artech House, 2002. Cripps is a top power-amplifier expert but mentions varactor diodes only in connection with small-signal predistorter.

S. A. Maas, The RF and Microwave Circuit Design Cookbook. Boston: Artech House, 1998.

U. L. Rohde, Microwave and Wireless Synthesizers. New York: Wiley, 1997.

W. H. Hayward, Introduction to Radio Frequency Design. Englewood Cliffs, New Jersey: Prentice-Hall, 1982.

G. D. Vendelin, Design of Amplifiers and Oscillators by the S-Parameter Method. New York: Wiley, 1982.

T. K. Ishii, Ed., Handbook of Microwave Technology, Vol. 1, Components and Devices. San Diego: Academic Press, 1995.

In conclusion, various text books show that some experts in this field teach against the idea of a power amplifier coupled to an electronically tunable output network that includes an electronically tunable reactive component or they show only small-signal applications. Other experts simply do not teach or suggest the idea.

Applicant would therefore respectfully ask the Examiner to consider that Bosse does not teach or suggest that "a power amplifier coupled to provide amplified signal to an electronically tunable output network, said power amplifier capable of being operated in a large-signal mode," as provided in claims 1, 40, and 56, as amended.

Bosse provides a tunable oscillator circuit for receiving a weak UHF signal at one of two frequencies that then provides that signal **to a UHF amplifier**, as described by Bosse in column 3, lines 19-22 and lines 33-34. Thus, the electronically tunable components of Bosse are not an electronically tunable output network of a power amplifier. Rather they are input circuits to other circuits, such as a buffer amplifier, a UHF amplifier, or a power amplifier. The electronically tunable components of Bosse receive weak signals that have not yet been amplified. They do not receive large signals.

Applicant would respectfully ask the Examiner to consider that common emitter

amplifier 50 is not a power amplifier. Bosse states its purpose: "any amplification differences for the two frequency bands are equalized. This is accomplished by connecting the output or collector electrode of the transistor 50 by means of a capacitor 51 to a tapping point 52 of the resonant circuit inductor 53." Thus, amplifier 50 is just for equalizing amplitude of the two weak signals as they pass through the circuit.

While Clar provides a power amplifier, there is no teaching or suggestion as to how to substitute a power amplifier for amplifier 50 and have the circuit of Bosse work for its intended purpose as a UHF receiving resonant circuit that feeds a power amplifier. Bosse would then have two power amplifiers, one before and one after his tunable resonant circuit. As described herein above, the tunable capacitors would introduce harmonics distorting the signal, and none of the references teach how to avoid that. It was applicant who accomplished that. More invention would be needed to make such a dual power amplifier device work properly, avoid distortion, and consider how to use it.

Clar does not teach or suggest electronically tunable reactive devices. He does not describe his variable capacitor or inductor as having capacitance or inductance that varies with bias and with signal level, as would be the case for electronically variable reactances subject to large input signals. Applicant would ask the Examiner to consider that Clar does not teach electronically tuned variable capacitors. His variable capacitors are mechanical. If the teachings of Clar were introduced into Bosse, as suggested by the Examiner, one of ordinary skill would also consider replacing the electronically tunable capacitors of Bosse with the mechanically tunable capacitors of Clar since mechanically tunable capacitors have a fixed capacitance that does not vary with amplitude of the applied signal. By doing so the harmonics would be avoided. Thus, even combining the references to produce the dual amplifier structure would still not produce the invention as claimed.

In view of the teachings of the text books cited, one of ordinary skill in the art would understand Clar's variable capacitor as being a standard mechanically variable reactive element, as found in many ordinary tunable electronic devices, rather than electronically variable capacitors.

In a mechanically variable capacitor, the plates are moved to change the capacitance. The capacitance depends on the position of the plates but in any position the capacitance is independent of the applied voltage. In essence, the variable capacitor becomes a fixed capacitor once the operator stops moving the plates. Consequently, one can apply a signal of any amplitude (short of breakdown, of course) and will see the same capacitance. Because in any position of the plates the capacitance is fixed and independent of the applied signal voltage, there will be **no distortion** of the applied waveform by the mechanically variable capacitor.

As described in the textbooks cited, in an electronically variable capacitor, the capacitance depends upon the instantaneous voltage (sum of bias voltage and instantaneously varying RF voltage) applied to it. Unlike a mechanically variable capacitor, an electronically variable capacitor does not become a fixed capacitor after one changes its value. While a mechanically variable capacitor will provide a capacitance that is independent of signal strength, this is not true for an electronically variable capacitor. Thus, while there is little difference in operation between small-signal and large-signal operation for mechanically variable capacitors, there is an important difference in operation for electronically variable capacitors.

In small-signal operation, the bias voltage is significantly larger, perhaps ten or more times larger, than the RF voltage. The RF voltage has little effect upon the capacitance of the electronically variable capacitor, which is substantially controlled by the much larger bias voltage. Thus, for small signals, the capacitance is essentially fixed as far as the RF is concerned, so the output RF waveforms are negligibly distorted by capacitance variation, and the harmonics produced are low. Previous uses for electronically variable reactive components are in small-signal applications in which the amplitude of the RF signal is a small fraction of the bias voltage or bias current so nonlinear variation is insignificant. This small signal mode of operation is used in the voltage-controlled oscillators, phase shifters, and small-signal tunable filters.

In large-signal operation, the RF voltage is now an appreciable fraction of the bias voltage (more than 1/10). The term "power amplifier" is defined in the specification beginning on page 25 in a section entitled "nomenclature and definitions." Nothing in the specification identifies this definition as an example, and the definition provided is consistent with that understood by one of ordinary skill in the art. The specification defines power amplifier on pages 25-26 as follows:

> In this specification and the appended claims, the term "power amplifier" is used to mean an amplifier operated in a large-signal mode in which its RF-output power is an appreciable fraction of its dc-input power... Class A amplifiers are distinguished from small-signal amplifiers by operation such that the peak output-signal power is **more than one tenth** of the saturated output power."

The clear definition of power amplifier provided herein is not inconsistent with the definition provided by the Examiner in the May 16, 2006 office action from an on-line dictionary called xreferplus, that a power amplifier is "an amplifier that is usually the final amplification stage in a device and is designed to give the required power output." Under the xreferplus definition, while a power amplifier is "usually" the final amplification stage, it can be elsewhere, such as the penultimate driver stage as well, as it sometimes is. Under the xreferplus definition a power amplifier is "designed to give the

required power output." The definition provides no indication of magnitude or relative magnitude.

The definition provided in the specification of the present patent application is more specific with regard to the relative magnitude of the power, however, more clearly distinguishing from small signal amplifier. This more specific definition is consistent with the ordinary and customary meaning of power amplifier that a person of ordinary skill in the art would apply at the time of the invention to distinguish from such small signal amplifiers as those provided in the references cited by the Examiner.

For example, in the book, *Electronic Engineering,* C. L. Alley and K. W. Atwood, Third Edition, New York: Wiley, 1973, page 354 (attached) states at the start of Chapter 11, "Power Amplifiers":

> A typical amplifier consists of several stages of amplification. Most of the stages are small-signal, low-power devices. For these stages, efficiency is usually unimportant, distortion is negligible, and the equivalent circuits accurately predict the amplifier behavior. In contrast, the final stage of an amplifier (and in some cases an additional driver stage) is usually required **to furnish appreciable power** to its load. Typical loads include loudspeakers, antennas, positioning devices, and so on. These amplifiers are **commonly called power amplifiers**. Because of this relatively high power level, efficiency becomes important. Also distortion becomes a problem because the amplifier parameters vary appreciably over the signal cycle.

The paragraph highlights the fact that a power amplifier is usually required to furnish appreciable power to its load for such loads as loudspeakers and antennas. The specification equivalently provides that "RF-output power is an appreciable fraction of its dc-input power."

For a circuit using an electronically variable capacitor the capacitance of the electronically variable capacitor now varies in response to the varying large signal RF voltage handled by the power amplifier. This means that capacitance of the electronically variable capacitor varies within the RF cycle as the RF swings positive and negative. While the bias voltage is still used to control the capacitance, the average capacitance now depends upon both the bias and the amplitude of the RF. And the instantaneous capacitance is varying with the RF input signal. The output RF waveform is significantly distorted because of the variation of the instantaneous capacitance with time varying magnitude of the input RF signal, and therefore, significant harmonics are produced.

Varactor diodes have been used with large-signals for intentional production of

those harmonic signals. In a frequency doubler, for example, a signal of frequency f is driven into the varactor through one filter and a signal at frequency 2f is extracted from the varactor through another filter. This is frequency multiplication, not power amplification. But this use illustrates the point that one of ordinary skill would be averse to using an electronically tunable capacitance for a power amplifier.

The electronically variable inductor has an analogous situation. It is controlled by current. The magnetic flux that circulates in the inductor is produced is a sum of bias and RF currents, leading to the same effects for electronically tunable inductors that would not occur for mechanically tunable inductors.

Thus, in providing for a power amplifier, that amplifies input signals having large signals, it would not be obvious to substitute electronically tunable capacitors and inductors for mechanically tunable capacitors and inductors. One of ordinary skill in the art would have expected that using an electronically variable reactive tuning device would result in signal distortion and production of significant power at harmonic frequencies, resulting in non-linear amplification and inefficient production of power at the desired frequency. One would conclude that linear amplification would be impossible.

Therefore, applicant would respectfully ask the Examiner to consider that one cannot simply drop an electronically variable reactance into the place of a conventional mechanically tuned reactance in a power-amplifier circuit. Thus, it is not obvious to combine the references. To provide the power amplifier of Clar without providing his mechanical capacitor problems would need to be overcome and additional invention would be needed. It was applicant who provided that recognition and that additional invention.

While one of ordinary skill would have thought the suggestion of an electronically tunable power amplifier unworkable because of the nonlinear effects produced by variation of the electronically variable components with signal level, as described in the above mentioned books, applicant recognized that the non-linearity problem posed by electronically variable reactances could be overcome and that such electronically variable reactances could be used in a power amplifier. Applicant was first to recognize that electronically variable reactance behave adequately as reactive elements in an amplifier, and that a substantial portion of unwanted harmonics could be filtered to provide a desirable output.

The present applicant provided additional circuit components to make the electronically variable reactances work in a power amplifier. As shown in FIG. 2 of the present application, he recognized that dc-blocking 31, 36 for electronically tunable capacitors 32, 37 and bias-feed components 33, 38, permit bias and control to be applied to the tunable component in a way that does not interfere with the high-power RF signal.

Simlarly, dc-blocking 55A, 55B, and 55C for electronically tunable inductor 56, and bias-feeds 33 53, 57 are shown in FIG. 4. Also, dc-blocks 236, 237, 238, 239 for electronically tunable capacitors 232, 233, 234, bias-feed components 240, and RF-bypass 242, 246 are shown in FIG. 22.

Second, the present inventor further realized that the nonlinearities were not entirely a show-stopper. For example, the present inventor realized that a harmonic component that is 20 percent of the amplitude of the fundamental causes significant distortion of the waveform, but constitutes no more than 4 percent of the power. Thus one can operate a power amplifier with an electronically variable reactance that is inherently nonlinear and at the most have a small reduction in the efficiency and output at the fundamental frequency of interest.

Third, the present inventor disclosed techniques for reducing or avoiding effects of the non-linear electronically variable reactive element. His novel solution was to use conventional reactances to trap the harmonics so that they don't reach the output or cause interaction of two nonlinear devices. He included at least one conventional component between the electronically tuned component and output to keep harmonic levels down. Thus, the output signal has reduced effect from the non-linear portion of the electronically tunable reactance, and there is minimal distortion of the output signal.

For example, a conventional inductor presents a high impedance to the harmonics, thus preventing significant harmonic current from flowing through. A conventional capacitor analogously presents a lower impedance to a harmonic, thus shunting it to ground.

One implementation of this technique is shown in FIG. 3, where conventional tuning capacitors 41 and 45 isolate electronically variable inductor 42 from output 28 and active device 20.

Another implementation is in FIG. 4, where conventional tuning capacitor 51 isolates electronically variable transmission lines 52 and 56 from active device 20.

In FIG. 7, fixed filter 70 isolates electronically tuned filter 11 from load 19.

In Fig. 15, conventional capacitor 130 and inductor 131 isolate electronically tuned filter 132 from active device 20.

In Fig. 22, conventional tuning inductor 230 isolates the voltage-variable capacitance of MOSFET 232 from the voltage-variable capacitance of MOSFET pair 233 and 234. Conventional tuning inductor 231 isolates the voltage-variable capacitance of MOSFET pair 233 and 234 from output 222 (which is coupled through transformer